

ENVIRONMENTAL IMPACT STATEMENTS

WATER ALLOCATION FOR THE ALABAMA-COOSA-TALLAPOOSA (ACT) RIVER BASIN AND APALACHICOLA-CHATTAHOOCHEE-FLINT (ACF) RIVER BASIN

USING RESERVOIR SYSTEM MODELING (HEC-5) AS BASIS FOR A PROGRAMMATIC EVALUATION FRAMEWORK (ACF RIVER BASIN ALLOCATION EIS)

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Abstract. This paper describes the role the HEC-5 computer program, "Simulation of Flood Control and Conservation Systems" in preparation of environmental impact statements (EIS) by a team of Federal agencies. The EIS addresses the range of potential environmental and socio-economic impacts for the future allocation of water resources within the Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) River Basins. The hydrologic model simulates the reservoir system operation of the ACT and ACF basins. The hydrologic modeling produces a range of flow conditions, which are anticipated to bracket the range of flow conditions that would result from any allocation of water resources. Hydrologic data, including reservoir elevation, streamflow, hydropower generation, and water supply withdrawals at key locations within the basin are provided to other elements within the EIS process to evaluate the potential environmental and socio-economic impacts.

INTRODUCTION

A complex interrelationship exists between surface water, groundwater, and the numerous competing demands on water resources in the ACF basin. A significant amount of information that is used in this presentation was developed and approved during the Comprehensive Study by the States of Florida, Alabama, and Georgia, and the Corps, who were partners in the study. The Corps, using tools developed during the Comprehensive Study, developed a reservoir system model of the allocation scenarios for this EIS. Data analysis and technical expertise on water quality issues addressed in this EIS were provided by the U.S. Environmental Protection Agency (EPA) (surface water quality) and the U.S. Geological Survey (USGS) (groundwater quality).

The water quantity modeling completed by the Corps provided

the basis for evaluating impacts on water availability, instream flows, and reservoir water level elevations. This information was also used by the cooperating agencies to evaluate the potential impacts on each of the other resources areas (biological communities, economics, etc.). The water quantity sections first describe the affected environment, presenting an overview of the resource in the ACF basin, and then present the environmental consequences of the no action and action alternatives.

WATER QUANTITY

The water quantity discussion addresses the amount of water in the ACF basin by examining such issues as flow rates, flow durations, and reservoir water levels. There are many factors that can affect water quantity, including weather, municipal and industrial (M&I) consumption, agricultural use for irrigation, and the operation of hydro- and thermal power plants, and flood control dams.

In the southeast U.S., rain falls nearly every month. However, the need for water in the summer and fall often is greater than the supply of water in the river basin. An important function of the many reservoirs in the ACF basin is to store water when there is an abundance of rain and to release water when there is less rain, ensuring that all water needs can be met throughout the year. This management of water is a complex process that must consider the many competing demands for water in the basin, take past and future hydrologic conditions into consideration, and determine the most appropriate operating conditions for all the reservoirs in the basin to optimize the use of water. The Corps takes an active role in water management in the ACF basin to supply water to meet the various competing demands. The various uses of water in the ACF basin include hydropower, navigation, water quality, water supply, flood control, fish and wildlife habitat, and recreation. Water demand can be consumptive or non-consumptive. Consumptive demands

withdraw water from the basin for some purpose and do not return it back to the basin. Municipal, industrial, and thermal power water supply consume a portion of the withdrawn water and return a portion of the water back to the basin as treated wastewater. For purposes of this analysis, agricultural water supply withdrawals are assumed to provide no return flow to the surface water streams. In contrast hydropower demand is a non-consumptive use of water. It uses the flow in the river to drive hydropower turbines to generate electricity, but no water is withdrawn or lost from the system.

ENVIRONMENTAL CONSEQUENCES

The HEC-5 model was used to evaluate surface water quantity impacts of the no action and alternative action flow scenarios on the major rivers and reservoirs in the ACF basin. The no action model of the ACF basin was built by the Corps in concurrence with the States during the Comprehensive Study. The Corps adapted and used the no action model during development of this draft EIS to compare the action alternative flow scenarios to the no action alternative.

The no action alternative and action alternative flow scenarios were simulated under 1995, 2020, and 2050 projected water demands. The action alternative for the purpose of this draft EIS is a range of minimum instream flows that would be likely to bracket any allocation formula that will be submitted by the States. Each of the three scenarios (low, moderate, and high release scenarios) was also modeled using 1995, 2020, and 2050 projected water demands. Thus, a matrix of model runs was set up for evaluation in this draft EIS.

The last major NEPA evaluations of water management operations at the various reservoir projects in the ACF basin were included in the environmental impact statements completed in the 1970s. To assess the impact of operational changes since that time, the HEC-5 model was also used to simulate conditions in the ACF basin under 1977 operations, which was selected as a representative year for historic operating conditions.

Basin Wide Hydrologic Modeling

To simulate the effects of the allocation formula on water resources, the Corps' Mobile District constructed, with assistance from the Corps' Hydrologic Engineering Center (HEC), a hydrologic model of all the major streams and reservoirs in the basin using a computer modeling program called HEC-5. The HEC-5 computer program, Simulation of Flood Control and Conservation Systems, was originally developed by HEC. It allows simulation of the sequential operation of any reservoir system configuration during a specified period of time. The Corps constructed the HEC-5 model of the ACF and ACT basins in consultation and in cooperation with the States in the Surface Water Availability study element of the Comprehensive

Study. The HEC-5 model, a tool to evaluate alternative water management scenarios, was constructed to simulate operation of the reservoirs and streams in the basin. The HEC-5 model uses 55 years of daily historic streamflow data (1939 to 1993), the physical and operational characteristics of reservoirs and river reaches, and the net consumptive water demands in the basin to determine basinwide surface water impacts for various operational scenarios.

The HEC-5 model was set up in a "node" framework, with 31 nodes representing the ACF basin. The nodes were selected to represent physical locations or critical modeling points, such as environmental points of interest, USGS stream gage locations, reservoirs, or other model-related control points. HEC-5 model outputs, in terms of predicted streamflows and reservoir elevations, were used to assess the impacts of operating the system under various management scenarios.

Development of the Low, Moderate, and High Scenarios

For the action alternative in the draft EIS, a range of reasonable, foreseeable minimum flows—low, moderate, and high—was developed to form a framework to evaluate the allocation formula now being negotiated between the States of Alabama, Florida, and Georgia. These flow scenarios do not represent a specific operational alternative. Instead, they are intended to bracket a range of flows that will include a flow represented by the final allocation formula. By analyzing this range of flows, it is reasonable to assume that the range for potential impacts of the actual allocation formula will be addressed as appropriate for a programmatic EIS. This EIS identifies and analyzes the range of impacts associated with this range of minimum flows.

The HEC-5 model was used to simulate conditions in the rivers and reservoirs of the ACF basin under three flow scenarios: low, moderate, and high. The flow scenario models were optimized for reservoir releases during the critical low flow periods: whether to release the highest flow rate and draw the reservoir to the lowest allowable elevation; to release the lowest flow rate and maintain the pool near the top the conservation pool; or to release a moderate flow rate between the low and high release rates. The descriptions selected to name the three flow scenarios describe conditions in the river under low flow/dry weather conditions in the basin. That is, under dry conditions, the low release scenario will provide lower river flows than the moderate or the high release scenarios. However, each scenario was modeled for the full 55-year period of record, with the same amount of water to be managed under each of the three scenarios. Considering that the mass of water must be conserved within the model, if flows are lower during the dry weather periods for a given scenario, the flows for that scenario may be higher than the other two scenarios at other times of the year, such as under wet spring conditions. To appreciate the full effect of each scenario, the impacts must be viewed and evaluated on a monthly or seasonal basis.

Each flow scenario was modeled using 1995, 2020, and 2050 projected demands. The 1995 demands were included to illustrate the immediate impact of implementing an alternative flow scenario. The 2020 and 2050 demands were modeled to show the mid-term and long-term impacts expected from implementing the water allocation formula, taking into account future projected water demands. Water demands were held constant in the HEC-5 model for each year of the 55-year period of record, even though in reality, water demand will fluctuate around a mean, depending on the amount of rainfall in a given year. The water demands used in the HEC-5 models were developed during the Comprehensive Study.

Impact Analysis Approach

The action alternative scenarios of high, moderate, and low flow are compared to the no action alternatives to provide direct impacts to water quantity. The impacts for current (1995) demands are evaluated, as well as the mid- and long-range impacts by analyzing the same scenarios under 2020 and 2050 year water demands. The impacts are categorized into six categories: river flow, reservoir elevation, groundwater resources, navigation, flood control and water supply.

Impacts to water resources in the ACF basin under the no action and alternative flow scenario will vary depending on where they occur in the basin. Because this is a programmatic EIS, impacts are analyzed on a basinwide basis rather than project by project. However, because impacts do vary over the basin, the basin was subdivided into four subbasins. The rivers and reservoirs within each subbasin were then analyzed as a group. For this programmatic analysis, one or two representative reservoirs and river flow locations were selected to summarize the analysis of the subbasin.

Subbasins were delineated according to hydrologic features within the ACF basin. The Chattahoochee River basin was subdivided into an Upper Chattahoochee River subbasin and a Lower Chattahoochee River subbasin. The Flint River subbasin was delineated as a separate subbasin because of its unique hydrologic nature. This subbasin is significantly affected by groundwater interaction. The fourth subbasin evaluated is the Apalachicola River subbasin. This subbasin was also delineated based on hydrology. The Apalachicola River is the flattest river in the ACF basin and also has very diverse and critical environmental resources in the lower Apalachicola River and Apalachicola Bay.

Direct impacts are the effects that a particular action has on the river flows and reservoir elevations in the basin. These effects occur as a direct result of the action. As discussed above, caution must be used in comparing the HEC-5 model results for the low, moderate, and high flow scenarios directly to the no action model results because of the modeling assumption differences between

the two sets of model runs. The low flow scenario and the high flow scenario can each be compared directly to the moderate flow scenario to assess impacts. Direct impacts of the no action alternative can also be displayed. However, only general comparisons between the no action alternative and the alternative flow scenarios can be made. Although this does not allow a precise value-by-value comparison, it is more than adequate to assess general impacts to water resources in the ACF basin for this programmatic draft EIS.

The analysis focuses on river flows and reservoir elevations that would occur as a result of the no action and action alternative flow scenarios during critical periods. The HEC-5 modeling focused on the critical periods because the target flows were established to ensure maintenance of the minimum flows throughout the critical drought periods. The critical periods also show the greatest impact of the alternative flow scenarios. Environmental consequences would also occur during non-critical periods as reservoirs and rivers are operated to maintain the different target minimum flows of each scenario. Impacts under average flow conditions over the full period of record are also presented within each subbasin.

DISCUSSION

The HEC-5 computer program, Simulation of Flood Control and Conservation Systems provides the reservoir elevation and instream flow at key locations to evaluate the potential impacts on each of the resource areas included in the Programmatic EIS. HEC-5 is an essential tool used by the Federal Agencies to adequately meet the requirements of the Programmatic EIS. In addition the three States, Alabama, Florida, and Georgia developing the allocation formula are use the HEC-5 program to evaluate their proposals. This provides a command analytical tool for the states and Federal government.

REFERENCES

- U.S. Army Corps of Engineers (Corps). 1998a. Draft Environmental Impact Statement, Water Allocation for the Alabama-Coosa-Tallapoosa (ACT) River Basin. Main Report and Appendices. September 1998.
- U.S. Army Corps of Engineers (Corps). 1998b. Draft Environmental Impact Statement, Water Allocation for the Apalachicola-Chattahoochee-Flint (ACF) River Basin. Main Report and Appendices. September 1998.